PLANE SURFACE DESIGN

(a) Irrigation Land Leveling

(1) General

Plane Surface Design (PSD) is a computer program to facilitate irrigation land-leveling design. The program will:

- Reduce topographic survey data (differential levels only). Previously reduced topographic data may be used instead of the raw data.
- Fit a plane to the problem area ("best fit" or user defined).
- Calculate the planimetric area and the volumes of cut and fill to construct the plane.
- Print grid map of the field area suitable for use in construction.

The program computes the earthwork volumes based on the average depth of cut and/or fill for the grid and/or fringe area. If both cut and fill occur in the same grid or fringe area, the volumes are adjusted according to the proportion of the cut or fill to the total depth of cut and fill for the area.

The average depth of cut and/or fill assumes that each stake represents 1/N'th of the grid or fringe area. Any deviation from this, caused by the shape of the area or the distribution of stakes around the area, can introduce an error, generally less than 1 to 2 percent, into the earthwork computations. Fringe areas are the only ones which can be shaped irregularly (grid areas are always rectangles); therefore, wherever possible, fringe areas should be convex polygons with the stakes more or less uniformly spaced around the perimeter.

(b) Program Capabilities and Limitations

(1) Plane Surface Design

This must be the first record of a job. This is an instruction to the program to initialize itself and prepare for a completely new job. This feature permits batching of jobs and insures that each job is independent of any other -- that no values are carried over from one job to another and that all program-assumed values are as described below.

- TITLE = data

  This control is used to load the job title records. Two title records must be loaded.

- GRID = program uses 100,100 if user does not submit grid dimensions.

  Equal sign and comma are required. Decimal point is not needed unless fraction of foot is used.

  ØRIGIN = $\{\frac{UPPER}{LOWER}\}, \quad \{\frac{LEFT}{RIGHT}\}$

  This control is used to cause the program to orient the output in the form most convenient for field use. The origin may be placed in the upper left, upper right, lower left, or lower right corner of the output sheets.

- SLØPE (X) = ^{S}min, ^{S}max *

  SLØPE (Y) = ^{S}min, ^{S}max *

  * Cross slope should be the same in both + and - direction.

  The slope of the plane may be restrained in either or both the X and Y directions. ^{S}min and ^{S}max are the minimum and maximum permissible

slopes in percent, not to exceed +/- 10 percent. The slope sign convention

used in the program is: If elevation increases moving away from the origin, the sign is positive (+); if the elevation decreases, the sign is negative (-).

- C/F RATIØ = data

  This control specifies the design ratio of excavation to fill yardage. It is used to account for compaction and materials wasted during the construction operations. This control must be used at least once per job. The program goes through a trial-and-error procedure to adjust the elevation of the plane so that the computed ratio is within 3 percent of the required value.

- BØRRØW = data

  This control is used to define the volume of material in cubic yards to be brought into the leveled area from an outside source. It is added to the cut volumes for balancing the cut/fill ratio.

- WASTE = data

  This control is used to define the volume of material in cubic yards that is to be removed from the leveled area. This option will provide extra material for a ditch berm, fill a gully, etc., for which definite volumes are desired. WASTE is added to fill volumes for balancing the cut/fill ratio.

- BM = data

  This control indicates that the vertical topographic data are field survey data (rod readings) and loads the benchmark elevation.

- BS = data

  This control is used to load a backsight to the benchmark or a foresight to compute HI for the following topographic data.

- FS = data

  This control loads a foresight as the first step of moving the instrument during the field survey.

- X + (x, y) = data

  X - (x, y) = data

  Y + (x, y) = data

  Y - (x, y) = data

  These controls are used to load topographic data that are predominantly in a straight line. The letter X or Y indicates the axis with which the line is parallel. The + indicates that the lines go away from the origin; the - indicates it goes toward the origin. X and y are the X and Y labels, respectively, of the grid point where the line begins.

  The data following the = sign is of two types. The first type is the vertical data for grid points that lie on the designated line. It consists of the elevation or rod reading only. The second type, always bounded by parentheses, is the horizontal and vertical data for observations that do not lie on the designated line or in the straightforward sequences. They may include observations that will later be used to define fringe areas. The data within the parentheses consists of three pieces of information:

  (i) The X position of the point being observed. It is the X-grid label or the X-grid label plus or minus a distance.

  (ii) The Y position of the point. It is the Y-grid label or the Y-grid label plus or minus a distance.

  (iii) The elevation or rod reading of the point *.

  * It should be noted that the use of rod readings is easier for both the person entering the data on the form and the person inputting the data.

- F(n) = data

  This control is used to define irregular fringe areas. "n" is a number assigned by the user to identify the fringe area. No two fringe areas may have the same identification number. There must be at least three observations for each fringe area. All observations must be enclosed within parentheses and consist of the same data as parts 1 and 2 or 1, 2, and 3 of the parenthetical X-Y data described above. Parts 1 and 2 only are required to refer to a point that is observed somewhere else in the topographic data.

  Grid labels in both the X and Y directions may be numbers or letters, but they must be consistent within a job. The first topographic record is analyzed to determine the convention being used and all succeeding uses must agree. If numeric labels are used, they start at 1 at the origin and increase by 1s up to the problem limit. When using alphabetic labels, the origin is A and goes up one letter at a time to the problem limit or Z. The next label following Z is AA, BB, etc., through ZZ or the problem limit.

- MAXELEV (x, y) = data
- MINELEV (x, y) = data

  These controls are used to set elevation limits at any point in the field. If the computed grade elevation of the point is outside the limits, i.e., greater than MAXELEV or less than MINELEV, the slopes of the plane are adjusted up to the slope limits, to raise or lower the grade elevation at the point. If the slope limits are such that the plane cannot be rotated enough, the plane is raised or lowered to meet the limits and a warning is printed. This eliminates the cut/fill ratio balance. If the slope limits are such that both elevation limits cannot be met, the field is raised to the MINELEV, MAXELEV is ignored, and a warning is printed.

- GØ, DETAIL

  This control tells the program that all data necessary for a run has been loaded and that computations are to begin.

- END JOB

  This is the last record of a job.